



# SUPPLYING AMMUNITION

THE LIFEBLOOD OF THE MILITARY





# EXECUTIVE SUMMARY

No part of the defense industrial base is more critical to the success of the U.S. military in conflict than that which produces munitions. At its most basic level, the function of the U.S. military in conflict is to place energy on targets. Everything else that the military does is to create the conditions that will allow sufficient energy to be deposited in a timely manner on such targets, the destruction of which will lead to the defeat of any enemy. It is ammunition that makes the military an instrument of war.

As a result of Iraq and the Global War on Terror (GWOT), the defense industrial base in general, and the munitions industrial base in particular, is being challenged to meet current and future requirements. Post-Cold War downsizing, consolidation and disinvestment has left the Department of Defense (DoD) in many instances hard-pressed to meet the logistics and supply demands of the GWOT. The period from the end of the Cold War to the present saw a 68 percent reduction in the overall capacity of the munitions industrial base. Today, the United States has but a single government-owned production facility for small caliber ammunition, a plant that was opened during World War II. Despite recent increases, funding levels still are not adequate to address the full range of demands confronting the munitions industrial base, including replenishing diminished stockpiles, modernizing production capabilities, and simultaneously, preparing for a future of advanced weapons and munitions.

The munitions industrial base faces serious challenges including an aging production base, single-point sources of supply, changing foreign dependencies, inadequate investment, shrinking stockpiles and a lack of surge or rapid replenishment capacity. The most immediate requirement for this sector is to increase the production of critical munitions, particularly small caliber ammunition. But production of critical, high-demand munitions must be expanded while efforts continue to make the munitions industrial base more efficient. This means targeted investments to boost the efficiency of key production lines, support for vulnerable and scarce component manufacturers, and the elimination of unnecessary capacity and divestiture of excess physical infrastructure.

At the same time, DoD must create a mechanism that will protect and preserve the newly expanded capacity when the inevitable decline in demand for munitions occurs. One part of the solution is to ensure stable, long-term funding. Multiyear procurements of ammunition could help to address this problem.

Another part is agreement on a munitions industrial base strategic plan. Such a plan is now in draft. A third part is to restore munitions industrial base planning for a surge/replenishment capacity.

For the long-term, the munitions industrial base must undergo its own transformation. DoD needs to invest in the future capacity of the munitions industrial base to produce advanced weapons that will be employed by a transformed fighting force. R&D funding must be maintained at an adequate level. Expanded public-private partnering must be encouraged and the private sector needs to be given incentives to invest in the munitions industrial base.

The initial draft of this report was written by Dr. Daniel Gouré of the Lexington Institute. All members of the Land Warfare Working Group had an opportunity to review and modify the final report.



# I. INTRODUCTION

**“Our trouble will never be raising soldiers. Our trouble will always be the limit of the possibility of transporting, clothing, arming, feeding and caring for our soldiers.”**

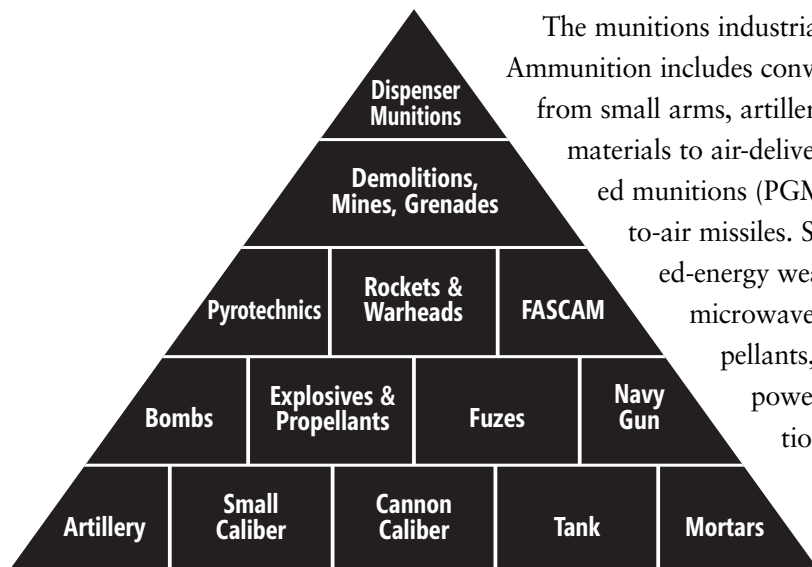
— Elihu Root

**“We can win without food, we cannot win without ammunition.”**

— General Walton “Bulldog” Walker, USA

In prosecuting the Global War on Terror (GWOT) and meeting the challenge of regional adversaries, the nation discovered that the U.S. military is a superb instrument of war. But the Nation also learned that it is an instrument not always adequately supported and sustained by the defense industrial base. Faced with rapidly increasing demand for a wide array of items, the defense industrial base has struggled to meet the military’s needs. This is not surprising since the industrial base has been under-resourced for much of the past 15 years. Parts of this industrial base are aging and have not been modernized in decades. This is particularly true of government-owned facilities. In addition, there are problems in the private sector. In many instances, the private sector is limited in its ability to rapidly expand production. There are numerous single-point sources of critical items in both the public and private parts of the defense industrial base. This system is straining to support a military that is itself overstretched.

No part of the industrial base is more critical to the GWOT than the ammunition sector. At its most basic level, the function of the U.S. military is to place energy — kinetic or photonic — on targets. Everything else that the military does is to create the conditions that will allow sufficient energy to be deposited in a timely manner on such targets, the destruction of which will lead to the defeat of any enemy. It is ammunition that makes the military an instrument of war.



**Ammunition Family Commodity Categories**

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The munitions industrial base is an exceedingly complex sector. Ammunition includes conventional kinetic and explosive munitions from small arms, artillery and mortar shells, mines and demolition materials to air-delivered bombs, the full array of precision guided munitions (PGMs), torpedoes, and air-to-air and surface-to-air missiles. Soon the munitions base may include direct-energy weapons, including lasers and high-powered microwaves. The component sub-sectors include propellants, explosive materials, pyrotechnics, fuzes, power supplies and guidance systems. The munitions industrial base is responsible for the full ammunition life cycle, including weapons R&D, production, stockpile management and demilitarization.



Encompassed within the munitions industrial base are a wide variety of facilities. Included in this sector are government-owned and -operated ammunition facilities, manufacturing arsenals and maintenance depots, government-owned but contractor-operated (GOCO) ammunition plants and contractor-owned and -operated facilities. Arsenals and depots produce little or no munitions but are involved in related activities including the installation, maintenance and repair of dispensing and launch systems.

The munitions industrial base faces unique challenges. The most immediate requirement of the munitions industrial base is to increase the production of critical munitions, particularly small arms, to meet the growing demand created by the GWOT. But it must expand the production of critical, high-demand munitions while simultaneously pursuing measures designed to make the munitions industrial base more efficient. This means targeted investments to boost the efficiency of key production lines, support for vulnerable and scarce component manufacturers, and the elimination of unnecessary capacity and divestiture of excess physical infrastructure.

The responsibility for supplying munitions, the lifeblood of war, to the military falls most heavily on the U.S. Army. The Army is DoD's Single Manager for Conventional Ammunition (SMCA). As the name suggests, the SMCA is responsible for ensuring that all branches of the U.S. military are supplied on a timely basis with the conventional munitions they require. While this definition includes over 300 items with 70+ items common to multiple Services and 120+ Service-unique items, such as air-delivered weapons and shells for naval guns,<sup>1</sup> it also excludes many munitions items, specifically guided munitions.

The munitions industrial base is increasingly challenged to meet the needs not just of the GWOT but of potential future conflicts too. The success of this sector in meeting current rapidly expanding demand for a wide range of munitions, particularly small caliber ammunition, has been by dint of heroic efforts on the part of individual private corporations and government facilities. Immediate action is necessary to strengthen the ammunition industrial base, thereby ensuring that the military has the munitions it needs to prosecute the GWOT. Moreover, its ability to meet expected future demand for increasingly sophisticated munitions could be at risk due to inadequate investment in advanced industrial processes and R&D. Unless both the near- and far-term needs of the ammunition industrial base are addressed now, the ability of the U.S. military to achieve the missions it is assigned will be placed at risk, possibly in this war but almost certainly in the next.

## II. FOR WANT OF A HORSESHOE THE KINGDOM WAS LOST

The recent history of the munitions industrial base has been one of consolidation, aging and, in the view of many, gradual decline. The period from the end of the Cold War to present saw a 68 percent reduction in the overall capacity of the munitions industrial base. The number of government-owned ammunition facilities shrank from 28 to around 13, with a corresponding reduction in production lines from 270 to 73 and in production personnel from 19,000 to 7,000. The number of privately-operated facilities fell from 163 to 69. At the time, this reduction appeared warranted in light of the end of the Cold War and the corresponding decline in defense budgets.

Operations Enduring Freedom (OEF) and Iraqi Freedom (OIF), as well as the broader GWOT, have spotlighted the U.S. defense industrial base's strengths and achievements, as well as its weaknesses and limitations.









One area of weakness highlighted by the GWOT in general, and OIF in particular, is the uncertain state of the ammunition industrial base. One instructive example of the problems facing the ammunition industrial base is that of small arms ammunition. As a result of continuing high levels of combat in both Iraq and Afghanistan, mobilization of National Guard and Reserve forces, and new training requirements for support forces, the demand for small caliber ammunition has increased fourfold from pre-GWOT levels.

The lack of sufficient stockpiles and limits on production of small caliber ammunition has had a serious and continuing impact on the U.S. military and its global operations. Deployed forces appear to have sufficient ammunition. However, both individual weapons qualifications and specialized advanced training had to be curtailed due to the shortage of small caliber ammunition. In addition, war reserves are reported to be down to dangerously low levels.

There exists but a single government-owned facility in the United States for the production of military specification small caliber ammunition for the entire U.S. military. This is the Lake City Army Ammunition Plant in Lake City, Missouri. This facility is government-owned and contractor-operated. The Lake City facility was opened by then-Senator Harry S. Truman during World War II. The reduction in government-owned ammunition plants was a direct response to changes in requirements and a desire for economies and efficiencies that argued against maintaining underutilized capacity.

Nearly a dozen other ammunition plants provide a range of other munitions for all the Services. The Iowa and Milan GOCOs, managed by American Ordnance, produce medium caliber ammunition and shells for tanks and artillery pieces. The Lone Star and Kansas ammunition plants, operated by Day and Zimmerman, produce submunitions and the Air Force's Sensor-Fuzed Weapon, respectively. The McAlester Army Ammunition Plant makes bombs for both the Air Force and the Navy. Explosives and propellants are produced at Holstein and Radford Army Ammunition Plants.

Production at Lake City has been dramatically increased and further increases are planned in an effort to meet the demand for small caliber ammunition from domestic sources. Between 2000 and 2004, DoD's purchases of small caliber ammunition have increased from some 350 million rounds to approximately 1.2 billion rounds per year. By 2005, this figure is expected to increase to approximately 1.7 billion rounds. These achievements underscore the importance of a dedicated facility instantly responsive to DoD needs.

However, Lake City is an aging facility, badly in need of additional investment in modern equipment.<sup>2</sup> For example, the 5.56mm Small Caliber Ammunition Modernization (SCAMP) production lines have shown the ability to rapidly increase production limited only by the availability of raw materials and the design capacity of the equipment. However, the SCAMP lines are run by antiquated computer systems that should be upgraded. Lake City is required to rely on a dwindling number of supporting manufacturers. The situation in the sector — and for the U.S. military — would have been far worse had not Alliant Techsystems, the company that has the contract to operate Lake City, taken steps a few years ago to acquire the near-bankrupt sole U.S. manufacturer of ammunition links and move their production capability to Lake City.

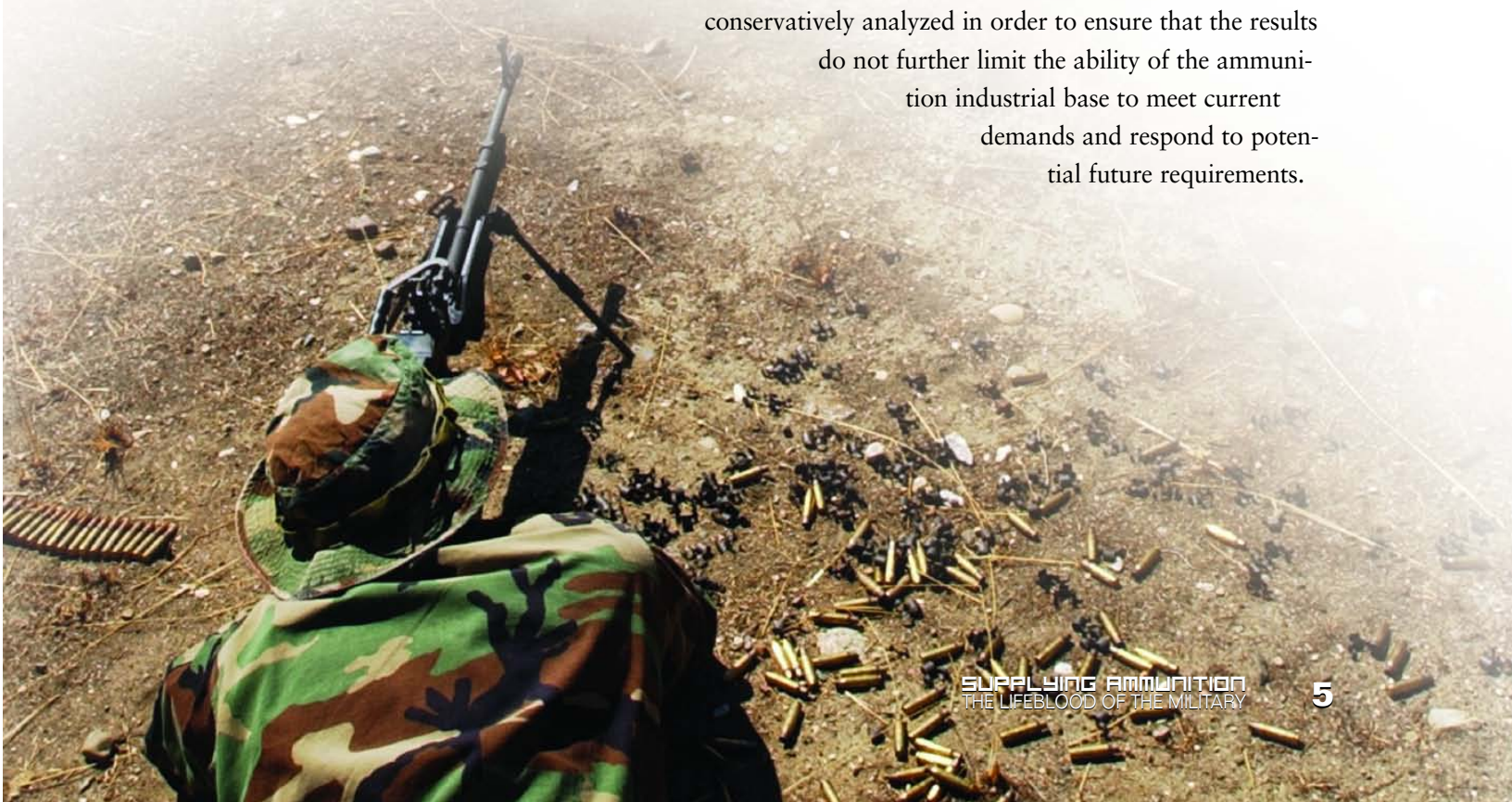
The reduction in the munitions industrial base was justified on several grounds. First, a smaller post-Cold War military had a reduced requirement for munitions. In 1991, there existed large munitions stockpiles left over from the Cold War. Second, the defense industrial base needed to apply the principles of supply-chain management, prevalent in the commercial world, which emphasized lean manufacturing and just-



in-time delivery. Third, it was assumed that future regional conflicts would be relatively short, with a breathing space before the next such conflict, allowing time to replenish military stocks. As a result, replenishment times for preferred munitions of two and three years did not appear to planners as posing a significant strategic risk. Fourth, the aforementioned strategic pause provided an opportunity to move from Cold War weapons systems and their associated production facilities to transformational capabilities that required new production facilities. Despite the absence of empirical evidence, it was often assumed that production rates could be rapidly increased in the event of a national emergency.

Procurement budgets have not been sufficient to maintain the health of even this reduced munitions base. As a result, there is evidence that the vendor base below the level of prime contractors is steadily weakening.<sup>3</sup> Single sources of qualified production now account for almost 25 percent of critical munitions components (71 of 302). In a number of instances, these suppliers have been forced to operate at uneconomical rates of production, threatening their financial stability. For some critical components, there exists no U.S. or Canadian supplier.<sup>4</sup> Surge capacity, in many cases, is extremely limited or nonexistent. Facilities can add extra personnel and operate their production lines in two or even three shifts. Such actions run the near-term risk of a decline in production quality, as well as a longer-term risk of wearing out machinery. Unfortunately, most munitions production facilities are constrained by the long lead-times involved in acquiring larger supplies of components.

Ironically, this current smaller and older munitions industrial base still is oversized. Most existing facilities operate at a fraction of their full capacity. Rationalizing this sector through targeted reductions of facilities would improve efficiency and reduce costs to the Government. However, while reducing excess capacity measured in terms of current requirements is desirable, it is more important to maintain a capability to respond rapidly to unplanned and changing circumstances. In peacetime, the focus is naturally on efficiency and minimizing costs. In wartime, the measures of success must be effectiveness and timeliness. At the end of the Cold War, the Government assumed that a period of peace had arrived and behaved accordingly. Sadly, the Government was wrong. Thus, plans for additional downsizing should be carefully and conservatively analyzed in order to ensure that the results do not further limit the ability of the ammunition industrial base to meet current demands and respond to potential future requirements.





DoD is at risk of not having access even to older-generation munitions. The Cold War era stockpiles are aging and have been depleted by a long series of military operations culminating in the GWOT. There are reports that some 60 percent of the Army's ammunition stockpiles are deemed to be in the category of "substitute," rather than the higher quality "preferred." The need for more ammunition to meet increased training requirements is reducing the size of munitions stockpiles and placing greater demands on the aging munitions industrial base.

There has been limited investment in facilities, production lines and production processes. This is one of the clear success stories resulting from the GOCO process and from the use of public-private partnerships. Nevertheless, more should and can be done. Existing facilities still lack modern machinery, employ inadequate quality control processes, and do not use modern business practices.<sup>5</sup>

At the same time as the munitions industrial base was consolidating, it was also evolving in response to changes in demand. The most dramatic change in the period came with the introduction of PGMs. In 1985, for example, the U.S. Air Force procured 128,000 unguided bombs and just 4,000 PGMs; in 2004, the Air Force procured 40,000 PGMs but only 9,000 unguided bombs.<sup>6</sup> While the largest fraction of the current PGM inventory are unguided bombs enhanced with smart kits (the obvious example is the Joint Direct Attack Munition), DoD plans call for the procurement of thousands of sophisticated PGMs, many of which will deploy multi-spectral sensors, netted communications nodes and even their own engines for powered flight. Current plans call for the introduction of precision artillery rounds such as the Excalibur and





Extended Range Guided Munition, and a new Precision-Guided Mortar Munition into the force in the next few years. By 2010, the United States will begin deploying “brilliant” munitions capable of a high degree of autonomous operations.

Another factor that could alter the character of the ammunition industrial base is the move to insensitive high explosives (IHE).<sup>7</sup> Once a concern primarily of the Navy, the replacement of existing munitions with ones containing IHE is of growing interest across DoD. However, IHE is more difficult to manufacture and more expensive than traditional high explosives. Current budgets and development timelines may not support the movement to IHE.

The trend towards so-called smart munitions may be exacerbating some of the structural weaknesses of the munitions industrial base. Because precision weapons are more effective than their less clever predecessors, the trend is for DoD to procure fewer of them. The result is smaller production runs, which results in greater financial hardship for the companies that produce such weapons. In addition, precision munitions require components of increasing complexity and sophistication. These components can present production bottlenecks and even strategic vulnerabilities. Virtually all smart munitions require their own power supplies for sensors and/or fuzes. This has created a demand for miniature batteries that can meet exacting military specifications in such areas as shelf life and adaptation to rugged environments. Such batteries have few commercial applications. Another type of critical component is fuzes, particularly advanced, smart fuzes. Over the past decade, the safing, arming and fuzing sector has been in a state of profound decline, shrinking from 31 firms in 1990 to 7 in 2002.<sup>8</sup> Experts point to other components, such as gun-hardened electronics, batteries and electro-explosives, as presenting additional areas of concern.

During the 1990s, DoD made a calculated decision to underfund the procurement of ammunition. War reserve requirements were reduced and the amount of resources tied up in munitions stockpiles was limited by buying less than was required to maintain even those reduced requirements. At the same time, DoD chose not to maintain sufficient standby capacity to provide for a rapid surge in production to meet emerging requirements. Now, as a result of the GWOT, this peacetime search for efficiency in the expenditure of defense dollars has run headlong into the wartime need for effectiveness, in this case defined as timely production of the needed quantity and quality of munitions.

The munitions industrial base faces a number of significant challenges in the near-term. These include:

- The age of plants and much of the equipment and infrastructure
- Excess capacity — in some areas — and infrastructure
- Numerous single-point sources of supply
- A growing dependence on foreign suppliers
- Disruptive fluctuations in demand
- Shrinkage and aging of stockpiles
- Declining R&D capability
- The lack of surge/replenishment capacity
- No incentives for private investments
- Commercial sources exiting the business
- The move towards PGMs





The current *Strategic Planning Guidance* establishes DoD's munitions-manufacturing policy. The munitions stockpile must meet peacetime needs, and it must support two near-simultaneous major combat operations (MCO). The munitions manufacturing base must be capable of replacing the ammunition expended in the larger of the two MCOs. The experience of the last three years, including OEF and OIF, suggests that without significant and sustained investment and improved management, the munitions industrial base will not be able to meet DoD's policy goals. A recent study identified a number of factors that challenged DoD's stockpile goals:

A period of limited perceived conventional warfare threats to U.S. interests but increasing threats of terrorism and regional conflicts, a large stockpile of increasingly obsolete conventional munitions that is expensive to maintain and manage, tight budget limitations within DoD and advances in electronics and the possibility of revolutionary improvements in energetics may make a large portion of our conventional weapons obsolete.<sup>9</sup>

Although munitions budget trends have improved over the past several years, funding levels are still not adequate to address the full range of demands created by the GWOT and also to replenish diminished stockpiles, modernize production capabilities, and prepare for a future of advanced weapons and munitions. In addition, the munitions industrial base now suffers from structural problems that are the result of more than a decade of downsizing, consolidation and realignment. That rationalization was necessary given changing demand and declining budget. Reversing these negative trends will require DoD to develop a strategic approach to the long-term evolution of the munitions industrial base and to provide consistently the funding necessary to achieve the objectives of that plan.



### III. MEETING THE EXPANDING AND CHANGING DEMAND FOR MUNITIONS

In truth, many of the challenges confronting the ammunition industrial base are not new. For years, experts have been warning that inadequate budgets for the purchase of munitions, the maintenance of relevant industrial facilities, the modernization of production capabilities, and the research and development of new munitions all threatened the viability of the munitions industrial base.<sup>10</sup> While it has been possible in areas such as information technology to rely much more on commercial products, munitions are a unique set of products with very few commercial analogues. As a result, a unique industrial base is required to produce them. But, because sufficient budgets were not made available to sustain the munitions industrial base, many private companies exited the market; those that remained were left without the resources to modernize their facilities or maintain spare/surge capacity.

The SMCA has an *Industrial Base Strategic Plan* for ammunition. The goals of the Plan are to ensure that current demands for ammunition are met in a timely fashion while simultaneously shaping a responsive, innovative and efficient manufacturing base. In order to achieve these goals, the SMCA must protect core capabilities while also seeking to enhance competition and private ownership.

The most immediate requirement of the munitions industrial base is to increase the production of critical small caliber munitions to meet the growing demand created by the GWOT. As noted above, the Lake City plant has expanded production nearly fourfold while also instituting business practice innovations to improve production and maintain quality; further production gains are expected over the next two years. The Army has sought out commercial and foreign sources of small caliber ammunition to provide a buffer while Lake City increases production and to hedge against even greater demand in the near future. However, the decision to go overseas or to commercial sources to fill the military's demand for ammunition can be justified only as a short-term expedient.

An acquisition strategy that engages private industry's capabilities to supplement Lake City's capabilities has both historical precedents and provides insurance against some future change in requirements. It also provides a relief valve as Lake City modernizes its production capabilities and expands both its capacity and its workforce...A prudent enhancement of commercial capabilities in addition to the expansion of Lake City's capacity is needed.<sup>11</sup>

In order to meet the increased requirement for small caliber ammunition, possibly for a sustained period of time, the U.S. Army is seeking to contract with a private corporation that will act as a "Lead System Integrator" (LSI) or "system-of-systems" manager to oversee the development of a second source of ammunition. This is a step towards developing an overall strategy for the small arms industrial base. The LSI would be responsible for assuring production of ammunition meeting military specifications to supplement that provided by Lake City.

It is difficult to overemphasize the need for additional resources to support modernization of facilities and manufacturing equipment. The entire ammunition production capability of the United States depends on the availability of nitrocellulose, which in turn depends upon the continuing operation of an aging and techno-





logically antiquated acid production facility at Radford Army Ammunition Plant. Should this single acid production facility be shut down, it could have serious consequences for the production of ammunition and, hence, for U.S. military operations worldwide. This acid plant is but one example of numerous single points of potential failure that exist throughout the munitions industrial base. The loss of production from any of these single points could shut down the production of numerous munitions.

Similarly, modest investments to refurbish existing operations and in new production technology at the Lake City facility could result in significant enhancements to that facility's production capacity and cost-effectiveness. There are estimates that between \$150 million and \$250 million dollars are needed to modernize Lake City's aging production equipment.

The private corporations that operate the government-owned munitions plants have made significant investments in those facilities. Nevertheless, the unpredictability of demand tends to make industry reluctant to make large investments in modernization, particularly if those investments can only be recouped over a long period of time.

DoD and the private sector have struggled to identify an approach to the munitions industrial base that would maintain the health of that sector and allow for critical investments while containing costs to the Government. Predictability in demand and stability in funding are critical to this goal. One way of achieving the desired outcome is through multiyear procurements of munitions. Multiyear procurements would enable private corporations to assess the return on investments they make in modernizing plant and equipment.





Consideration needs to be given also to investments that maintain and enhance the production capacity of critical component manufacturers. Some second- and third-tier suppliers have received federal production line expansion subsidies. The Army needs to aggressively fund ammunition Manufacturing Technology, or MANTECH, projects designed to inject modern manufacturing processes and equipment into the munitions industrial base, resulting in cheaper, higher-quality ammunition. The MANTECH program is also critical to the improved production of basic components such as metals, composites, ceramics, energetics and electronics that contribute to ammunition and other sectors of the defense industrial base. The Army should also continue to fund initiatives such as the Totally Integrated Munitions Enterprise program. The TIME program seeks to demonstrate a distributed, flexible manufacturing capability that is cost-effective and can be rapidly reconfigured as needs change. A plan must be developed to address the problem created by the lack of domestic sources for critical items. Such a plan should explore all options (stockpiling, creation of a domestic source, identification of reliable foreign sources, etc.). Where necessary, the SMCA must be prepared to exercise its authority, under Section 806 of the 1999 *Defense Authorization Act*, to restrict the procurement of conventional ammunition to sources within the national technology and industrial base.

DoD, the Services and industry recognize the need to make the munitions industrial base more cost-effective. To this end, efforts have been made, which continue to the present, to reduce excess infrastructure and rationalize production capabilities. For example, over the past few years, Joint Munitions Command (JMC) has reduced its infrastructure by nearly a million square feet of floor space. The Base Realignment and Closure (BRAC) process is intended to eliminate excess infrastructure, thereby saving money. BRAC may also offer an opportunity to improve the efficiency and lower some costs associated with the munitions industrial base.

One area of significant progress has been the restructuring of the munitions supply chain intended to ensure the adequacy of munitions supplies and their timely delivery to forces in the field. As part of its transformation strategy, the Army continues to create new organizations and re-emphasize existing organizations to enhance the linkages between warfighters and the national logistics system. The first of these is the Joint Munitions Command, a renaming of the former Operations Support Command, which officially stood up in January 2003. This name change emphasized the Joint DoD munitions sustainment and logistics mission of the JMC in their role as the SMCA Field Operating Agency. Another is Program Executive Office (PEO) Ammunition, which stood up in October 2002. PEO Ammunition is responsible for R&D and production of most Army-unique and multi-Service munitions. The Secretary of the Army has delegated to the PEO Ammunition the authority to perform the functions associated with the Single Manager for Conventional Ammunition.



More recently, the Army Materiel Command (AMC) and the Assistant Secretary of the Army (Acquisition, Logistics and Technology) jointly established Life Cycle Management Commands (LCMC), within the AMC structure. Each LCMC aligns the prior AMC subordinate command with the allied PEOs with which it works. The LCMCs are expected to be fully operational during the second quarter of fiscal year 2005. Today, the JMC and PEO Ammunition are responsible for the entire ammunition life cycle: procurement, production, storage, supply, stockpile management, quality assurance, safety, readiness inspection, maintenance, renovation, shipping, receipt, issue and demilitarization. As a result of the LCMC change, conventional ammunition management will be unified and integrated under a single chain of command.

Another step by the Army is the establishment of the Ground Systems Industrial Enterprise (GSIE), encompassing all the Army's arsenals and depots associated with ground combat systems support. The creation of the GSIE is an important step in the implementation of AMC's strategy for transforming its business practices. According to the AMC strategy for transformation:

The GSIE is a consolidation of all ground systems manufacturing and maintenance facilities into a single operating business unit to efficiently utilize the core capabilities of each facility while simultaneously transforming those core capabilities to meet the new technology and equipment demands under Army transformation.<sup>12</sup>

Some experts have suggested that one way of reducing the high costs associated with the munitions and improving the industry's efficiency would be by transferring many of its assets to the private sector.<sup>13</sup> Proponents of this approach argue that DoD is already highly dependent on the private defense industrial base for the production of a wide array of critical items. Ammunition, it is argued, should be treated no differently than missiles, tanks or aircraft. The SMCA's *Strategic Plan* calls for an assessment of the extent to which government-owned facilities can be transferred to the private sector.

Although such a move makes sense theoretically, it fails to sufficiently account for a number of factors that militate against such a strategy. Foremost among these are the unique nature of this sector and the limited alternative markets for its products. A second important factor is unpredictability of demand. A third factor is the lack of adequate spin-off potential for the unique capabilities and know-how present in the current small caliber ammunition sector. Together, these factors virtually preclude the creation of a reasonably stable business environment. Even if these factors were satisfactorily accommodated three other factors would preclude any private sector entrance. They are: insurance liability, environmental liability and taxes. As a result, it is difficult to believe that complete privatization of the ammunition base would ensure that a robust and responsive capability would be maintained.

## IV. THE LONG-TERM TRANSFORMATION OF THE MUNITIONS INDUSTRIAL BASE

The long-term transformation of the munitions industrial base will be driven by the concomitant transformation, first of the warfighting forces and second, of the logistics system that supports them. Emerging strategic and operational concepts emphasize extremely swift power projection from long distances, the extensive use of precision strike capabilities, non-linear maneuver, reduced logistics footprints, and rapid transition in the phases



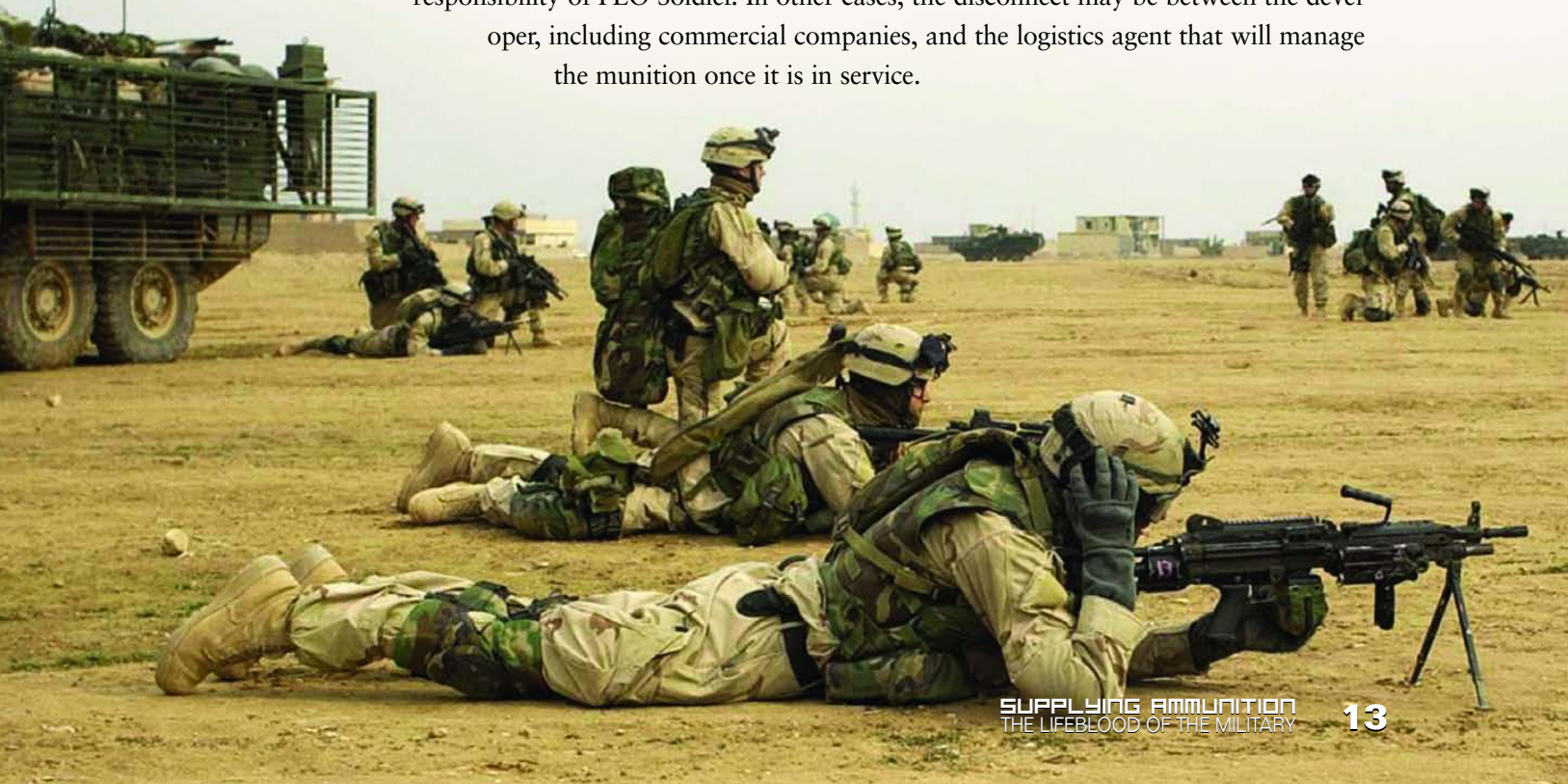


of conflict. The drive to network-centric warfare is creating demand for entirely new types of munitions incorporating state-of-the-art technologies. Weapons will become more capable and lethal, hence reducing the requirement for large numbers. The Army's Stryker and Future Combat System (FCS) programs point the way to a future in which armored vehicles are smaller and have less storage. Concerns for rear-area security and rapid logistics support will increase demand for smaller, lighter-weight munitions. Finally, the growing interest in enhanced force protection and survivability, as well as in reduced collateral damage, will create a greater interest in new types of explosives, propellants and warheads.

Technology is also leading to the creation of new types of weapons, some based on non-traditional physical principles. Improvements in sensors and position location will permit reductions in the size and payloads of some weapons with equal or even greater lethality. The military is extremely interested in next-generation explosives that are insensitive and also possess, preferably, a significant increase in power. Thermobaric explosives will provide enhanced effects against targets in enclosed areas. Directed-energy weapons (both lasers and high-power microwaves) are currently in development for air, sea and land-based applications. Solid-state lasers in the 100kw range could be employed as fire-and-forget munitions.<sup>14</sup> New small caliber ammunition is planned for both the Objective Individual Combat Weapon (OICW) and the Objective Crew Served Weapon (OCSW), as well as for standard ammunition.

Logistics considerations need to become part of the initial design work for new weapons systems. Too often in the past, logistics considerations were treated, at best, as afterthoughts. This is no longer possible. It will be important to manage the development of new weapons systems and their munitions in tandem.

For this reason, it is important that the Services remove remaining organizational and management barriers that contribute to disconnects between weapons systems PEOs and those responsible for munitions. For example, management of Army missile programs remains split between PEO Ammunition, PEO Air and Missile Defense/PEO Missiles. Similarly, the responsibility for munitions to be used by the Army's FCS rests with PEO Ground Combat Support Service, and that for the OICW and the OCSW are the responsibility of PEO Soldier. In other cases, the disconnect may be between the developer, including commercial companies, and the logistics agent that will manage the munition once it is in service.



The increasing reliance in defense production on commercial off-the-shelf (COTS) technologies is both an advantage and a disadvantage for the munitions industrial base. COTS is important as both a way of gaining access to state-of-the-art technologies and as a way of achieving greater cost effectiveness in munitions production. Yet, this means that technology cycles get shorter. DoD will find it increasingly difficult to tolerate aging in the munitions industrial base. Contrast a generational cycle time in microprocessors of approximately 18 months with a munitions industrial base that has production equipment dating back to World War II.

In some ways, the challenge is even more complex. The munitions industrial base must transform while simultaneously sustaining current high demand for its products.<sup>15</sup> There is a requirement to continue production of traditional items while also modernizing selected elements of the industrial base, introducing transformational production capabilities and retaining capability for rapid expansion of production. Thus, some production items will have very short technology cycles and require continuous stockpile turnover while others will have very long shelf life and a different maintenance and management scheme.

It has been suggested that ammunition needs to be treated as an acquisition program and not a commodity, thereby encouraging continuing modernization of both the end-item and the associated production technologies. A potential danger in such an approach is that the ammunition component of a weapons acquisition program will not get adequate attention or funding. As the technology content of modern munitions increases, the character of their development, production and stockpiling is likely to resemble that of platforms and major weapons systems. The concept of spiral development is one that may be very applicable to advanced munitions with their potential for repeated modification and improvement.

DoD needs to invest in the future capacity of the munitions industrial base to produce advanced weapons that will be employed by a transformed fighting force. A healthy research and development base is critical to maintaining a vigorous production base. Over the past 15 years, the capability and capacity of the R&D base declined at a rate that may have out-paced the production element. The solutions to shore this up are a much more complex problem than doing a better job of defining requirements and increasing procurement. Restructuring the organic R&D elements can lead to elimination of duplicate capability that is very apparent across the Services in the munitions and armament sector. “Rightsizing” is a necessary step before proper investments can be made in the recapitalization of facilities, staffing or equipment in the R&D base. If BRAC proceeds, it is a valuable opportunity to restructure the research element of the base, leveraging capabilities between the Services, the national labs and industry.

Industry has attained a higher competency level in some areas of research and engineering expertise than remains within the Army’s R&D establishment. The Army needs to conduct an unbiased analysis of industry’s research and engineering capability and rationalize investments in areas where industry does not have a leading edge, rather than trying to re-establish the lead within the Army R&D infrastructure. The Army should also take steps to provide the necessary infusion of funds to areas where industry is state-of-the-art.

In addition to rationalizing its R&D infrastructure, it is important to ensure that R&D funding must be maintained at an adequate level. Support must be given to the exploitation of opportunities for utilizing COTS in the design of future munitions.







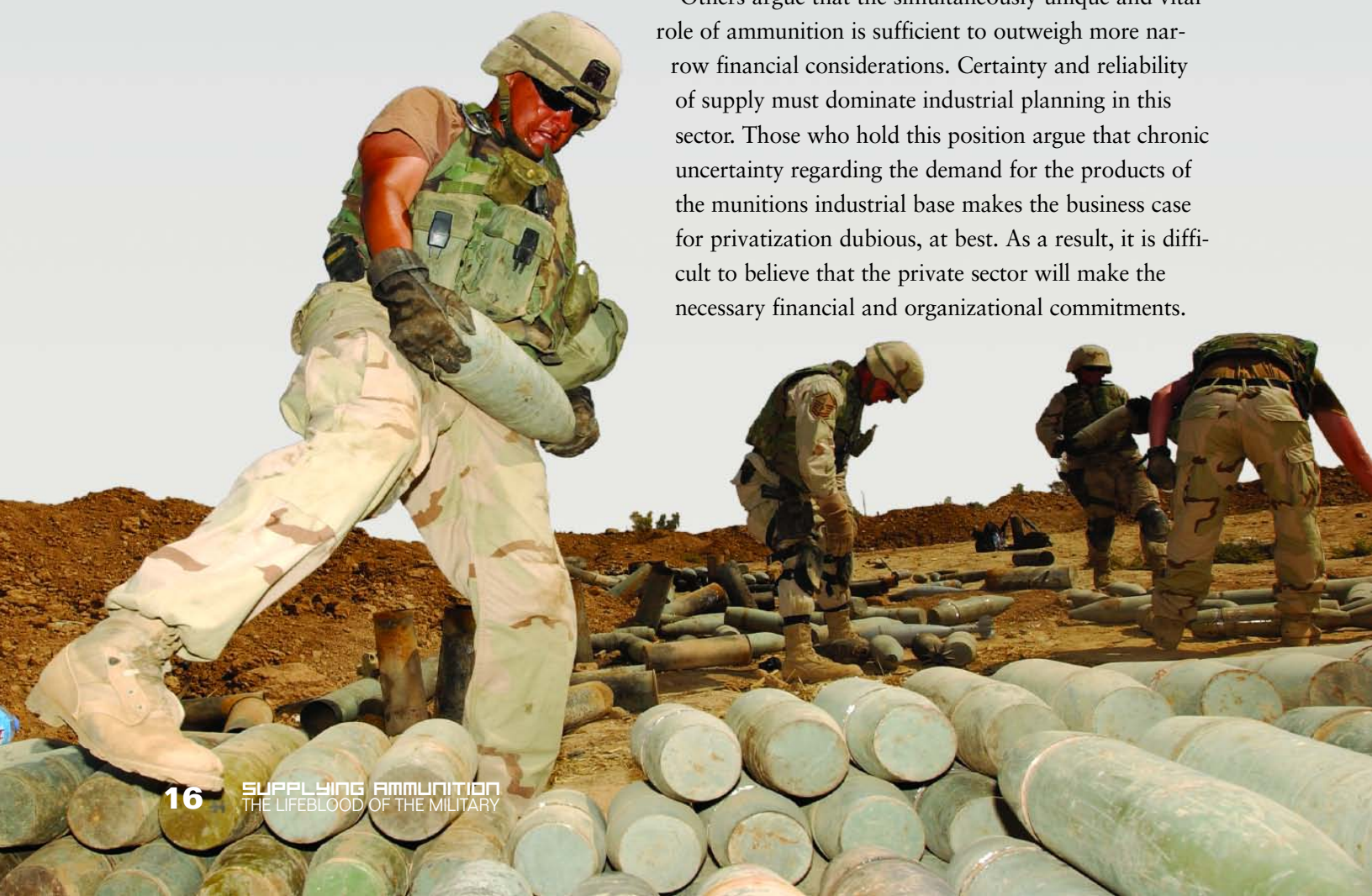


For the long-term, DoD needs to transform the relationship between government and industry. The *AMC Transformation White Paper* described a vision of the future munitions industrial base thus:

The transformed munitions base will consist of a complementary and synergistic mix of private sector and government capabilities. It will be multi-purpose and multi-use, and structured to provide the required capabilities and capacity to satisfy peacetime and war needs including reconstitution and replenishment. The lines between government-owned, government-operated facilities and the commercial sector are blurring, as innovative partnerships enable co-utilization of space and transfer of new technologies and capital equipment into the facilities. By leveraging the private sector's capabilities to the maximum extent practicable and economical, the Army will focus its resources on those manufacturing processes and products unique to the national security mission. The challenge is to determine the most efficient public-private partnership arrangements to provide for peacetime, mobilization capability and capacity and wartime support of both current and new systems.<sup>16</sup>

The U.S. munitions industrial base is a vital and irreplaceable national resource. Proponents of a strong munitions industrial base differ as to the best way of maintaining critical capabilities at an acceptable price. Some argue that the base should be completely privatized. Those who hold this view also see little harm in dependence on foreign suppliers so long as there are multiple sources for any critical item. This “global procurements” approach is the most efficient.

Others argue that the simultaneously unique and vital role of ammunition is sufficient to outweigh more narrow financial considerations. Certainty and reliability of supply must dominate industrial planning in this sector. Those who hold this position argue that chronic uncertainty regarding the demand for the products of the munitions industrial base makes the business case for privatization dubious, at best. As a result, it is difficult to believe that the private sector will make the necessary financial and organizational commitments.





In addition, proponents of a secure domestic munitions industrial base argue that dependence on foreign suppliers creates an unwarranted liability.

Both solutions carry costs and risks. Advocates of privatization and dependence on the global industrial base must be able to demonstrate that this approach will guarantee availability of munitions when they are needed. They must also address what measures they would take to deal with unexpected contingencies or political events that might change the reliability of foreign suppliers. In addition, they must be able to assure DoD that critical knowledge and skills will not be lost as a result of otherwise well-meaning efforts by the private sector to reduce their costs.

Those who support a strong government role in the munitions industrial base and limits on the use of foreign suppliers must make the case that this sector of the defense industrial base is sufficiently unique to warrant different treatment than other sectors and that the additional costs imposed by their strategy are necessary and acceptable.

## V. CONCLUSIONS AND RECOMMENDATIONS

Ammunition is the lifeblood of the military. Having the right types of munitions in sufficient quantities is critical to success in combat. Ensuring that the military can acquire the ammunition it needs and get it to where it is required when it is needed is a matter of vital military necessity. Attainment of this goal may be compromised by a lack of adequate domestic capacity or dependence on foreign sources of supply. Maintaining a robust domestic capability to produce the range of munitions needed by the military is a matter of national security. The use of foreign sources, which are often subsidized quasi-government entities, contributes directly to the deterioration of the domestic base and should be avoided, wherever possible.

The protection of a core capability to produce ammunition is vital to overall U.S. national security. The question is how best to do this. One model worth considering is treating the munitions industrial base like a public utility, much as many states and communities do their power and water systems. While private companies own and operate the facilities, they are guaranteed a certain revenue stream. Adjustments in pricing are done to ensure the viability of the utility. Hence, when demand goes down, prices may actually rise to ensure the company can maintain capacity, modernize plant facilities and remain profitable.

An obvious counter argument to the public utility model notes the rather predictable and stable demand for the utility's product and service when compared to the previously noted instability and fluctuations in demand for munitions. The revenue guarantee necessary to operate such a "munitions utility" may not be as attractive as that for a public utility. The counter to this negative argument is that production for war stocks can be employed to even-out demand for ammunition.

DoD must create a mechanism that will protect and preserve the newly expanded capacity when the demand for munitions declines in the future. Part of the solution is to ensure stable, long-term funding. An integral part of funding stability is constancy in material requirements. DoD needs to consider ways of projecting force structure requirements that have some level of stability so that the industrial base can deliver those requirements when and as they are needed. However, as recent events have demonstrated,









this can be very difficult to achieve in practice. A second step in the right direction is to restore the ammunition industrial base planning for all go-to-war munitions and to make the necessary investment today in providing the capability for rapid increases in production of select ammunition, thereby mitigating potential wartime and post-war vulnerabilities.<sup>17</sup> This not only makes strategic and financial sense, but it is the only way to create interest in the private sector towards making its own investments in the munitions industrial base.

It is a common misconception about the defense industrial base that it has no problems that cannot be fixed if given a sufficient allocation of resources. With respect to the munitions industrial base, this is not the case. What are most important are a strategic vision and a long-term management plan. Part of such a plan must be a definition of the long-term budget requirements for a modern munitions industrial base. Other aspects of this plan should be the development of multi-year production contracts that ensure that economic quantities of ammunition are procured. The plan should also identify critical sub-sectors and component technologies that must be sustained for the national industrial base. The finalization of the SMCA's *Industrial Base Strategic Plan* could be the basis for managing the long-term health of the munitions industrial base.

However, additional resources are critical to the future capability of the munitions industrial base. Funds must be provided to assure adequate production of currently needed items, to “rightsize” the industrial base, and to assure future capacity on an ongoing basis. This includes the principle components of the small caliber ammunition sector as well as the sectors involved in the production of propellants, fuzes and critical electronics. There are unique portions of the munitions industrial base such as the load, assembly and packing facilities and the Radford Army Ammunition Plant that need to be sustained. In some instances, the introduction of improved business practices and accounting/tracking systems may be sufficient. But in truth, too much of the production capacity of the munitions industrial base is aged and even obsolete. Money needs to be spent now to modernize critical production capabilities in both government-owned and private-industry facilities. Incentives are required so that private industry will see the business case for modernizing facilities. As one leading expert on the sector observed recently, “The munitions base is ripe for recapitalization.”<sup>18</sup> But, without funding stability and a transparent, long-term strategy, the private sector is unlikely to make substantial investments in munitions production.

DoD is preparing to implement a new round of infrastructure reductions and consolidations under the heading of Base Realignment and Closure. One objective of the current BRAC process must be to consolidate the ammunition industrial base. Virtually all experts in this field acknowledge that excess capacity exists in this sector. It is difficult to spend additional funds to modernize the base when money is being wasted to support excess capacity. Modernization and rationalization must go hand-in-hand. However, care must be taken to ensure that any downsizing not imperil the ability of the munitions industrial base to respond to changes in demand.

One potential option that could contain costs while preserving capability is to consolidate ammunition R&D and procurement among the Services. Experts argue that there are few if any fundamental differences between what the Army does at Picatinny Arsenal and what the Navy does at Naval Surface Warfare Center (NSWC) Indian Head, NSWC Dahlgren, and NSWC Crane. Similarly, with regard to basic research and formulation, there is little or no difference between what the Naval Air Warfare Center does at China



Lake and the Air Force does at Eglin Air Force Base. Yes, there are significant differences among the Services in individual ammunition items. But the set of critical skills, process and equipment overlaps.

The Executive and Legislative branches need to agree on an approach to this sector that maintains sufficient excess industrial infrastructure — in other words, a surge capability to ensure against critical stockpile failures. The sector's surge capacity survives only on the aging and obsolescing remnants of World War II and Cold War investments. Without question, maintaining excess infrastructure, in terms of peacetime demand for munitions, is costly. Failing to maintain an adequate surge capacity in the event of hostilities, as the Nation has discovered over the past year, can be deadly.

Finally, the U.S. Army and DoD must come to terms with the potential supply vulnerabilities created by loss of domestic suppliers. There are many single sources of supply for critical items. In a number of cases, critical components are no longer produced in the United States or Canada. Under what conditions does dependence on single or foreign sources of supply become a vulnerability? There is no simple answer to this question. But it is important that this question be answered and that a policy be put in place to address those areas where vulnerabilities exist.

According to the SMCA's *Industrial Base Strategic Plan* for 2015, the foremost goal is to balance industrial base and acquisition risk management. Simply put, this means ensuring that the ammunition industrial base can meet current requirements at an acceptable cost while also guaranteeing that the skills, assets and capabilities necessary to meet changes in demand are protected. Historically, DoD has tended to emphasize the former over the latter. The GWOT and OIF are stark reminders of the risks that are incurred when attention is not paid to the overall health and capacity of the ammunition industrial base. As the base continues to consolidate and shrink it is vital that DoD take those actions, including the provision of additional resources, required to guarantee a robust, responsive and modern ammunition industrial base.

## End Notes:

<sup>1</sup> Alan R. Beuster, "Update on Industrial Issues," Presentation to ICAP, February 12, 2002, p. 4.

<sup>2</sup> The Government has invested some \$70 million dollars in Lake City. Alliant has also invested tens of millions of dollars. However, modernizing this one-of-a-kind facility requires up to \$200 million in additional funding.

<sup>3</sup> The Industrial College of the Armed Forces, Industrial Study 5240-14, *Munitions*, National Defense University, Fort McNair, Washington, D.C., Spring 2003, p. 6.

<sup>4</sup> MG Wade H. McManus, U.S. Army Joint Munitions Command, "Industrial Base: Front and Center," a presentation to the Atlanta XXIX Conference, NDIA, April 28-30, 2003, p. 16.

<sup>5</sup> Sandra Erwin, "Munitions Sector 'in Trouble' Despite New Funds," *National Defense*, December 2001.

<sup>6</sup> *Munitions*, *op. cit.*, p. 5.

<sup>7</sup> IHE are those explosives that are relatively insensitive to shock, friction or heat compared to commonly employed explosives.

<sup>8</sup> ICAF Seminar 10, *Munitions: An Industry in Peril*, The Industrial College of the Armed Forces, Fort McNair, Washington, D.C., June 6, 2002, p. 16.

<sup>9</sup> National Materials Advisory Board, *Munitions Manufacturing: A Call for Modernization*, The National Academies Press, Washington, D.C., 2002, p. 133.

<sup>10</sup> Steven Mullen, "Ammunition Readiness: Current Problems and Future Implications of Army Transformation," Landpower Essay No. 02-1, Institute of Land Warfare, February 2002.

<sup>11</sup> Richard G. Palaschak, "Statement," House Committee on Armed Services (Tactical Air and Land Forces Subcommittee), June 24, 2004, p. 5.

<sup>12</sup> U.S. Army Materiel Command, *Transformation White Paper*, July 2003, p. 7.

<sup>13</sup> W. Michael Hix, et al., *Rethinking Governance of the Army's Arsenal and Ammunition Plants*, The RAND Corporation, MR-1651-A, 2003.

<sup>14</sup> *Munitions*, *op. cit.*, p. 16.

<sup>15</sup> McManus, *op. cit.*, p. 8.

<sup>16</sup> AMC, *op. cit.*, p. 6.

<sup>17</sup> Mullen, *op. cit.*, p. 6.

<sup>18</sup> Palaschak, *op. cit.*, 7.







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